PNEUMATICALLY POWERED PUMP

TECHNICAL FIELD

This invention relates to pumps for elevating fluids, and more particularly, to gas-operated diaphragm pumps.

BACKGROUND ART

A variety of pumps are in use for removing oil and other liquids from wells. The type of pump selected for use on a particular well is dictated by a number of factors, including the liquid to be pumped.

Submerged mechanical displacement pumps, operated from the surface by reciprocating sucker rods, are conventionally employed to elevate oil to the well surface. Such prior pumping systems, however, are often undesirable to the extent that they entail substantial movement of metal parts which corrode and abrade. Previously developed mechanical pumps produce a relatively limited volume of oil during each pumping cycle, and require relatively large amounts of power in operation. The close tolerances required in manufacturing the parts of such pumps also make the pumps relatively expensive to produce and maintain.

Mechanical displacement pumps normally require a large apparatus located above the ground. A sucker rod and associated machinery must be placed above the well, constituting an eyesore. In certain circumstances, mechanical displacement pumps cannot be used at all because local zoning laws prohibit placement of the large apparatus necessary for operation.

Since mechanical displacement pumps have a large number of moving parts, they are susceptible to breakdowns. These breakdowns are expensive and timeconsuming, resulting in large amounts of down time for the pump. In an oil well, such down time is costly because the well produces no revenues, yet incurs large expenses in the repair operation.

A need has thus arisen for a pump for use with oil wells which is not subject to the disadvantages noted above, but which provides improved pumping operation with reduced energy requirements.

SUMMARY OF THE INVENTION

In accordance with one aspect of the invention, a device for elevating subsurface liquids comprises a housing adapted to be placed in a well bore and submerged in the liquids. A supply conduit is connected between the housing and the surface for supplying pressurized gas to the housing. An exhaust conduit connected to the housing conducts the liquids to the well surface. An elastic diaphragm located in the housing is in fluid communication with the exhaust conduit and the well bore. The elastic diaphragm moves in response to a pressure differential between the diaphragm and the pump body to displace the liquid contained therein. A piston is slidably disposed in the housing and is attached to the diaphragm. A spring is secured between the piston and the housing for supporting and expanding the diaphragm.

In accordance with another aspect of the invention, a down hole pump for pumping liquid comprises a pump body adapted to be placed in a well bore and submerged in the liquid. A gas pressure conduit connects the pump body with the well surface and supplies pressurized gas to the pump body. An exhaust conduit connected to the pump body conducts the liquid to the well surface. An elastic diaphragm disposed in the pump body moves in response to the existence of a pressure differential between the diaphragm and the pump body for displacing liquid from the diaphragm when the pressure in the pump body is greater than that in the diaphragm, and for expanding with the liquid when the pressure in the pump body is lower than that in the diaphragm. A one-way valve is connected between the diaphragm and the exhaust conduit. A perforated, hollow limit tube is disposed about the longitudinal axis of the pump body and conducts liquid in the diaphragm to the exhaust conduit. A piston, slidably disposed in the pump body, is attached to the diaphragm. A spring is secured to the piston and the pump body for supporting the diaphragm in the pump body and for expanding the diaphragm. A second one-way valve provides fluid communication between the diaphragm and the well bore.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention and the advantages thereof, reference is now made to the following Detailed Description taken in conjunction with the accompanying Drawings in which:

FIG. **1** is a cross sectional view of an embodiment of the invention;

FIG. **2** is a cutaway view of the present invention taken along the line **2—2** in FIG. **1**;

FIG. **3** is a view of the present invention taken along line **3—3** in FIG. **1**; and

FIG. **4** is a view of the diaphragm of the present invention, with part of the diaphragm cut away to illustrate its construction.

DETAILED DESCRIPTION

Referring to FIG. **1**, the pneumatically powered diaphragm pump **10** of the present invention is illustrated. The pneumatic pump **10** has a pump body **12** of generally cylindrical shape. The pump body **12** is preferably made of steel to resist corrosion and to provide strength.

The pump body **12** includes a pump head **24** which is threadedly connected to the pump body **12** at the threads **25**. A sleeve head **26** with grooves **27** about its circumference threadedly connects into the pump head **24**. The pump body **12** has a lower section **14** joined at the threads **16**. A limiting stop **18** is connected to the lower section **14** at the threads **20**. A tail pipe **22** is integrally connected to the limiting stop **18**.

Two conduits **28** and **30** connect the pump **10** to the surface through the pump head **24**. The exhaust conduit **30**, threading into the pump head **24** at bore **32**, exhausts liquid from the pump **10** to the well surface. An O-ring seal **34** fits between exhaust conduit **30** and bore **32** of pump head **24**. The conduit **28**, supplying pressurized gas from the well surface to the pump **10**, threads into a bore **36** in the pump head **24**. An O-ring seal **38** is disposed between the gas pressure conduit **28** and the pump head **24**.

An oil-resistant cylindrical diaphragm **40** is disposed within the pump body **12**. The cylindrical diaphragm **40** is molded into the sleeve head **26**, though other methods of attaching the cylindrical diaphragm **40** to the sleeve head **26**, such as threads, will be suggested to those of skill in the art. The cylindrical diaphragm **40** threads into a piston **44**, disposed in the pump body **12**, at the threads **46**. In its fully extended position, the cylindrical